



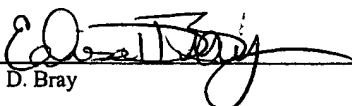
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PATENT

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Elise D. Bray

Applicant : Hyunsook Jung, et al.  
Application No. : 09/775,315  
Filed : February 1, 2001  
Title : POSITIVE ACTIVE MATERIAL FOR RECHARGEABLE LITHIUM BATTERY AND METHOD OF PREPARING SAME  
  
Grp./Div. : 1745  
Examiner : Julian A. Mercado  
  
Docket No. : 41671/DBP/Y35

**RULE 132 DECLARATION**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Post Office Box 7068  
Pasadena, CA 91109-7068  
August 6, 2003

Commissioner:

I, Hyun-Sook Jung, hereby declare that:

1. I received a bachelor's degree in chemistry from Han-yang University in 1996 and a master's degree in chemistry from KAIST in 1998. I have been employed by Samsung SDI Co., Ltd. since 1997. My responsibilities involve research in the area of active materials for lithium ion batteries, and I consider myself an expert on active materials for lithium ion batteries.

2. I prepared two cells containing different positive active materials. The first positive active material was made in accordance with the invention and contained a lithium manganese oxide and a lithium nickel manganese oxide in a weight ratio less than one. The second positive active material was made as a comparison and contained a lithium manganese oxide and a lithium nickel manganese oxide in a weight ratio greater than one.

(c) 3. The inventive positive material was prepared by mixing  $\text{LiMn}_2\text{O}_4$  with  $\text{Li}_{1.03}\text{Ni}_{0.8}\text{Mn}_{0.2}\text{O}_2$  in a mortar in a ratio of 20:80 wt%. The mixture, along with acetylene black ( $62.5 \text{ m}^2/\text{g}$ ) as a conductive agent and polyvinylidene fluoride ( $1.30 \text{ dl/g}$ ) as a binder, were weighed in a weight ratio of 94:3:3, and they were dissolved in a N-methyl-2-pyrrolidone solvent to prepare a positive active material slurry. The slurry was coated on Al-foil (with a thickness of  $60 \mu\text{m}$ , including the thickness of the foil), and the coated foil was dried in an oven at  $135^\circ\text{C}$  for 3 hours. The dried foil was pressed to produce a positive electrode. Thereafter, a coil-type half-cell was manufactured in a glove box using the positive electrode and a lithium metal reference electrode.

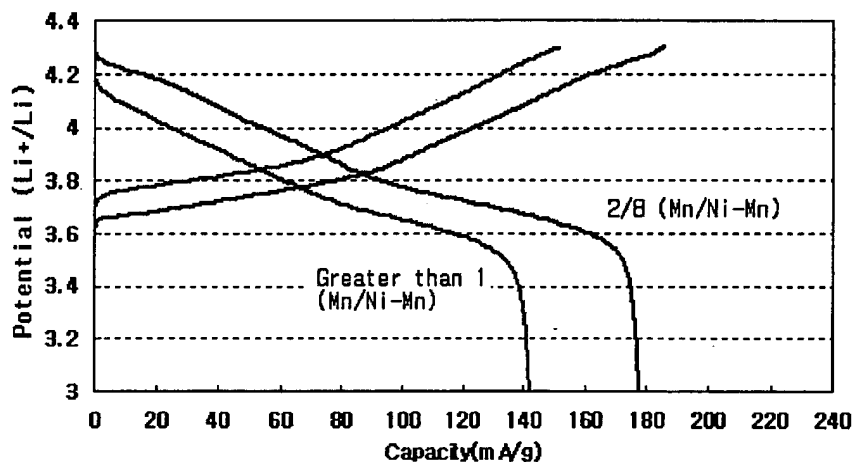
(b) 4. The comparative (non-inventive) positive material was prepared by mixing  $\text{LiMn}_2\text{O}_4$  with  $\text{Li}_{1.03}\text{Ni}_{0.8}\text{Mn}_{0.2}\text{O}_2$  in a mortar in a ratio of 60:40 wt%. The mixture, along with acetylene black ( $62.5 \text{ m}^2/\text{g}$ ) as a conductive agent and polyvinylidene fluoride ( $1.30 \text{ dl/g}$ ) as a binder, were weighed in a weight ratio of 94:3:3, and they were dissolved in a N-methyl-2-pyrrolidone solvent to prepare a positive active material slurry. The slurry was coated on Al-foil (with a thickness of  $60 \mu\text{m}$ , including the thickness of the foil), and the coated foil was dried in an oven at  $135^\circ\text{C}$  for 3 hours. The dried foil was pressed to produce a positive electrode. Thereafter, a coil-type half-cell was manufactured in a glove box using the positive electrode and a lithium metal reference electrode.

5. The half cells were charged and discharged at  $0.1\text{C}$  at  $4.3\text{V}$  to  $3.0\text{V}$ , and the discharge capacity was measured. The results are shown in Table 1 and Figure 1, below.

Table 1

Mn/Ni-Mn	Discharge capacity (mAh/g)	Overall result
Greater than 1	142	Not good
2 / 8	179	Good

Figure 1



6. As can be seen from Table 1 and Figure 1, the discharge capacity of the cell containing a positive active material according to the invention is superior to that of the cell containing the comparative positive active material. In my opinion, the superior results achieved using the inventive positive active material were unexpected.

7. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date Aug. 5, 2003

By Hyunsook Jung  
**Hyun-Sook Jung**

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